ECN

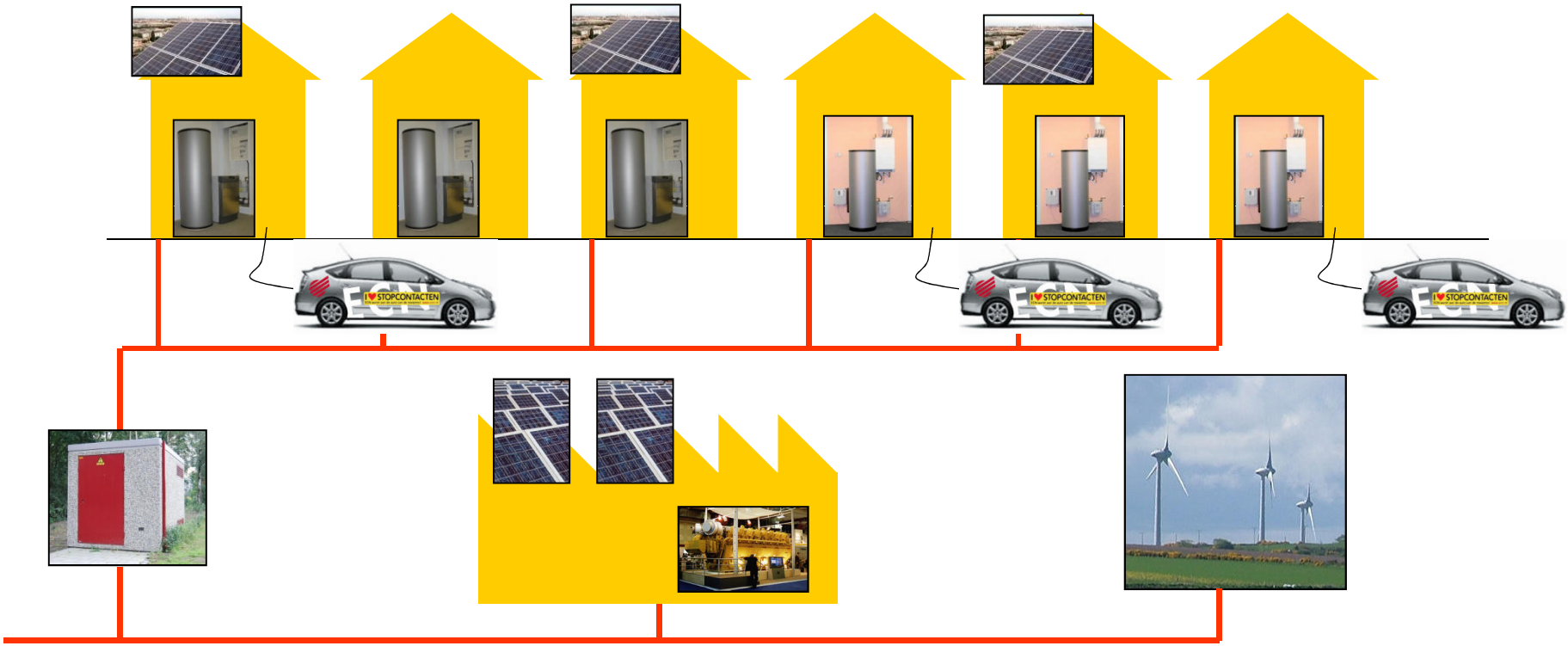
Energy research Centre of the Netherlands

POWERMATCHER

smartgrid technology

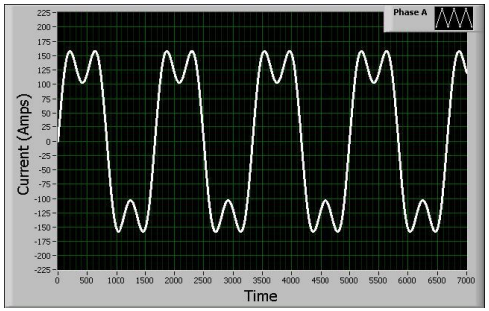
www.ecn.nl

A street in 2020.....



Challenges

Supply & demand Management



Power Quality

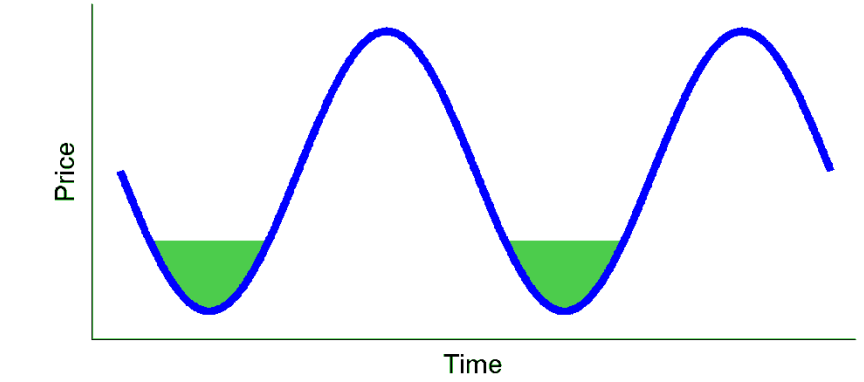
Congestion Management

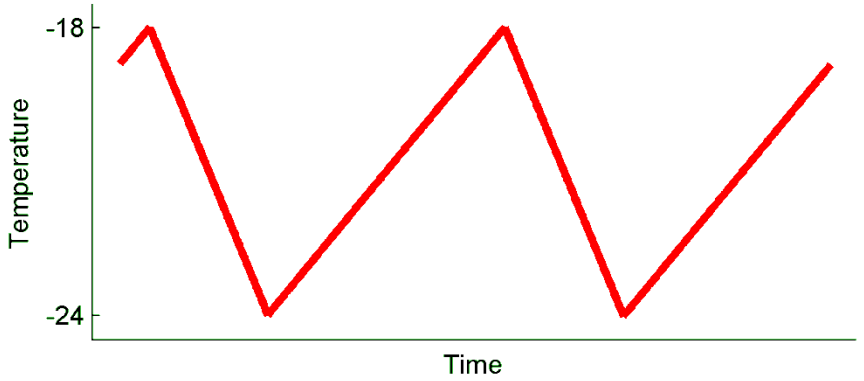
Reliability

What does the prosumer/consumer wants?

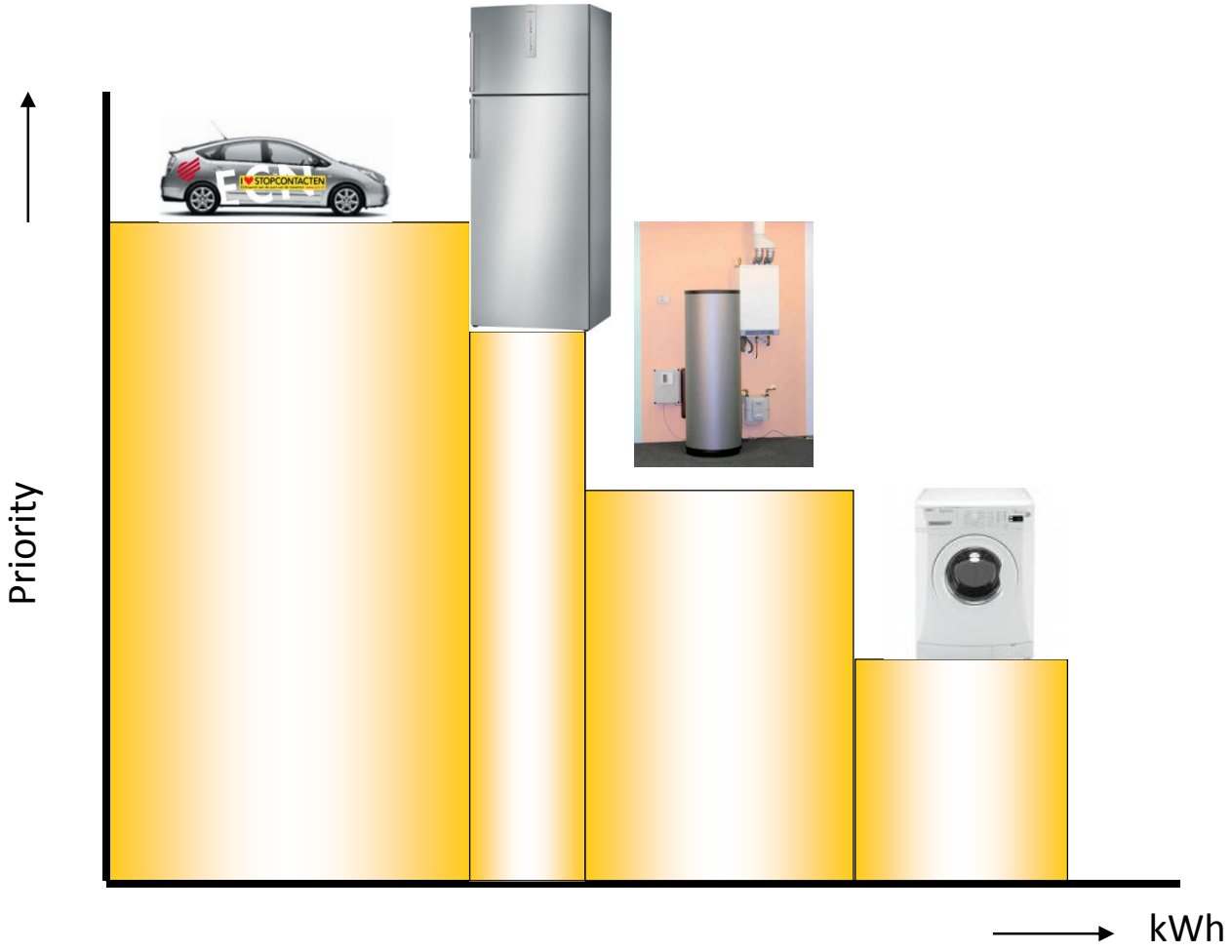
She

- wants to minimize the costs for electricity
- wants to reduce her carbon-footprint
- has flexibility to offer
- but does not want to be bothered with it
- …. and decide for herself

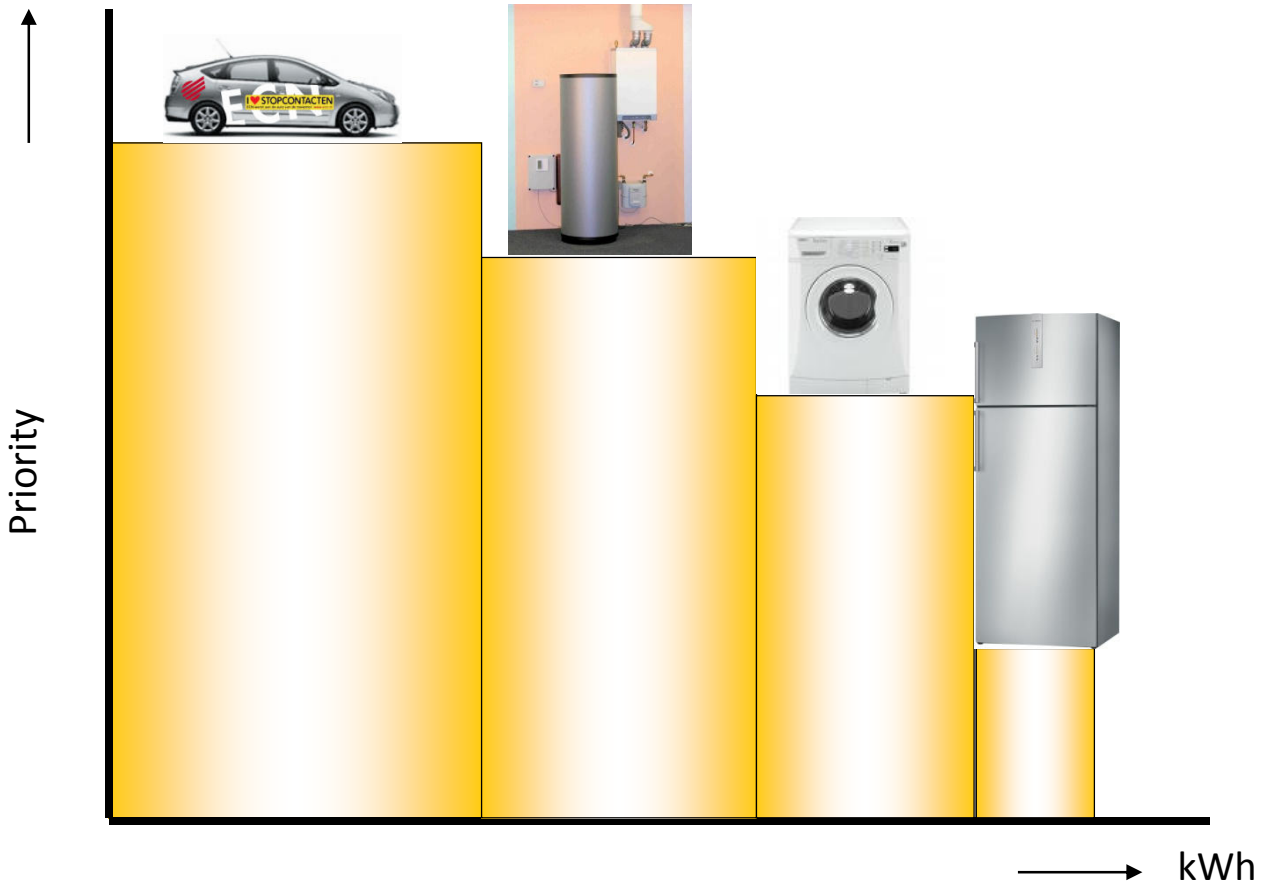

Price
Time


-18
-24
Temperature
Time

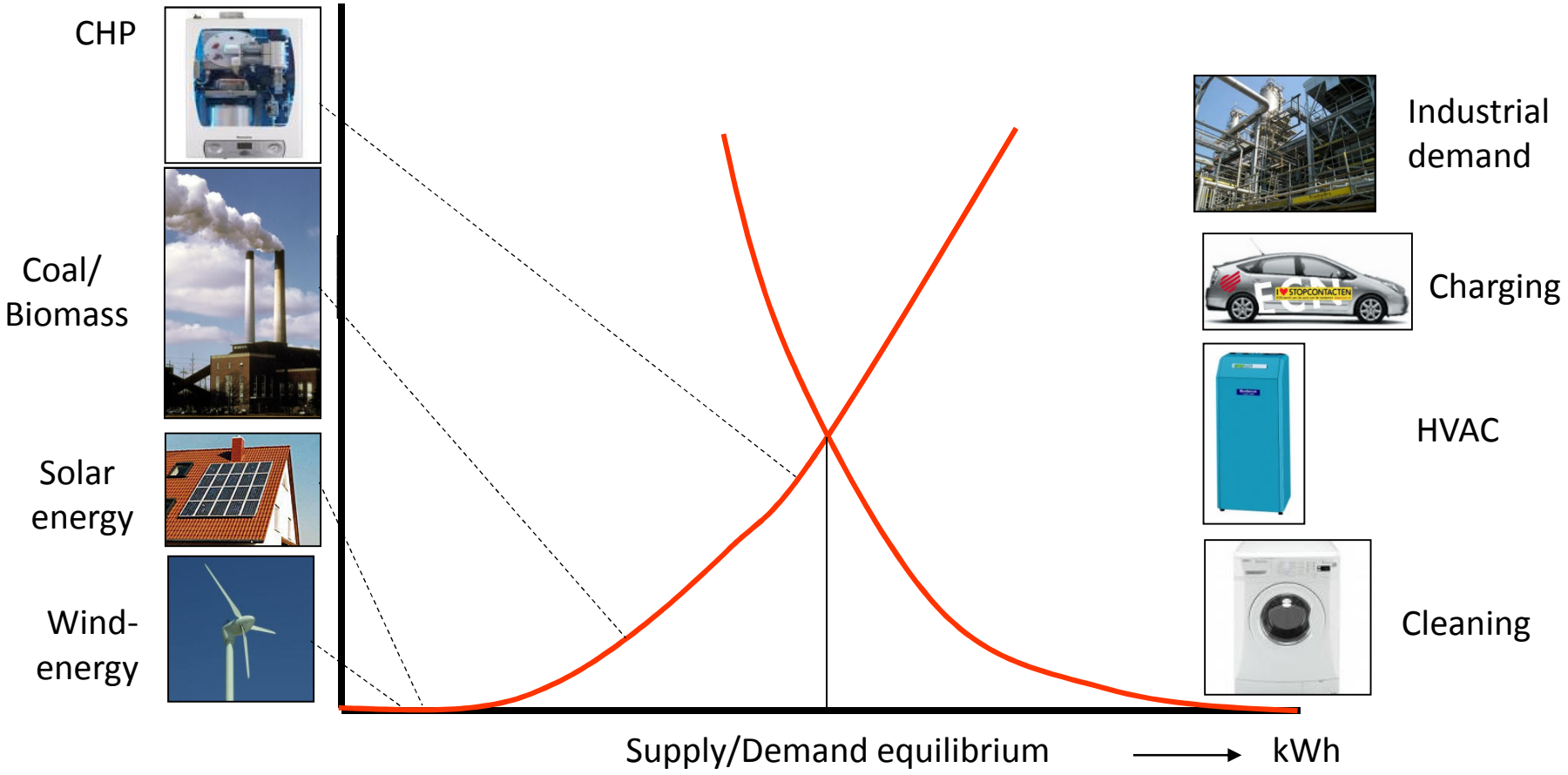
Everything has a price…



Everything has a price….



Electronic markets



PowerMatcher : ICT solution for clustering of devices

Scalability:

- Large numbers of devices (supply & demand)
- Distributed over a large area
- ‘Centralized control’ has limitations

Open system:

- Devices can connect and disconnect
- All (future) devices must be able to join
- Integration of renewables

Multi-actor interaction:

- Optimization of different processes (locally and globally)
- Coordination exceeds ownership

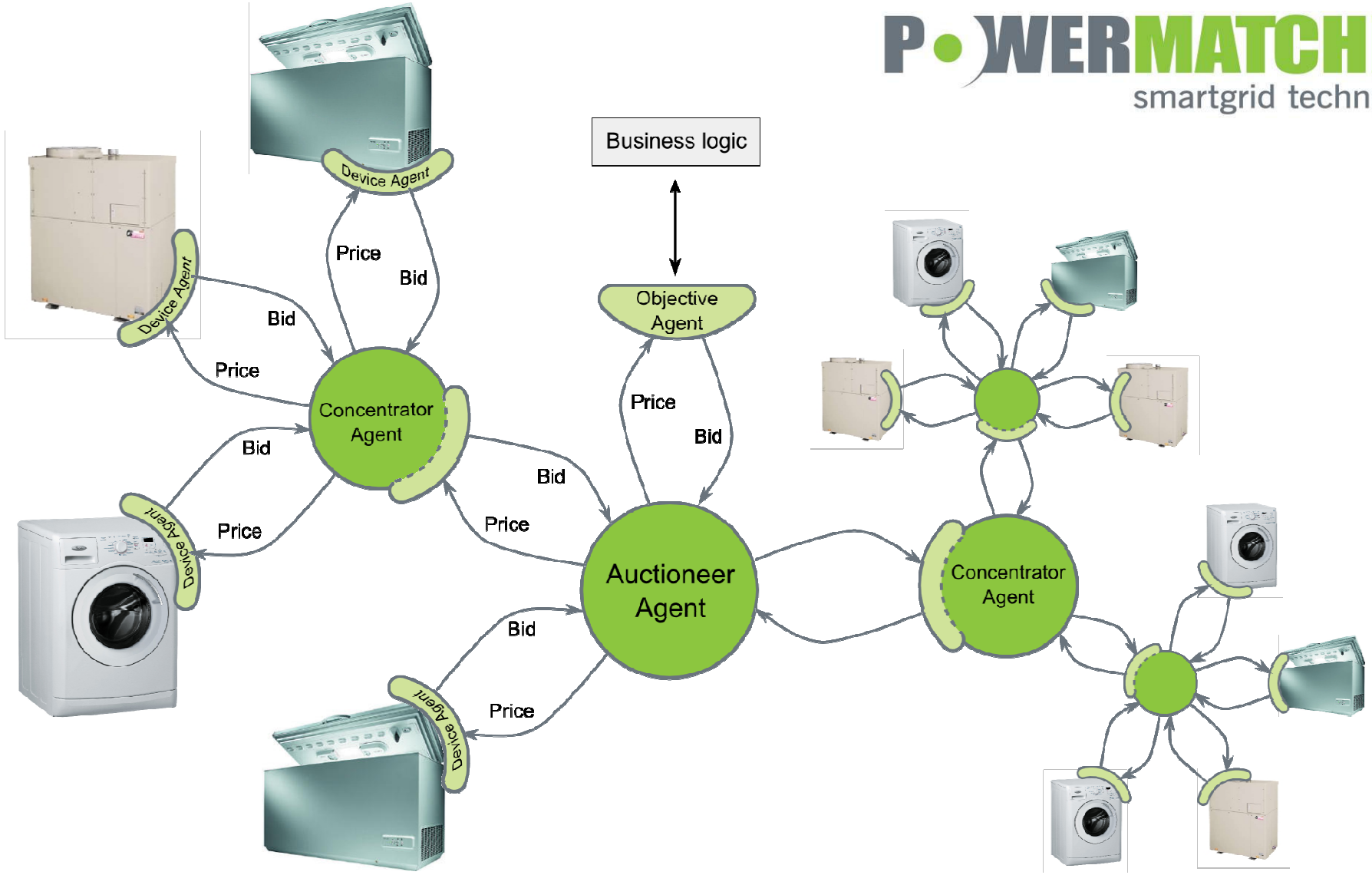
In accordance with existing energy markets

Multi-Agent Systems

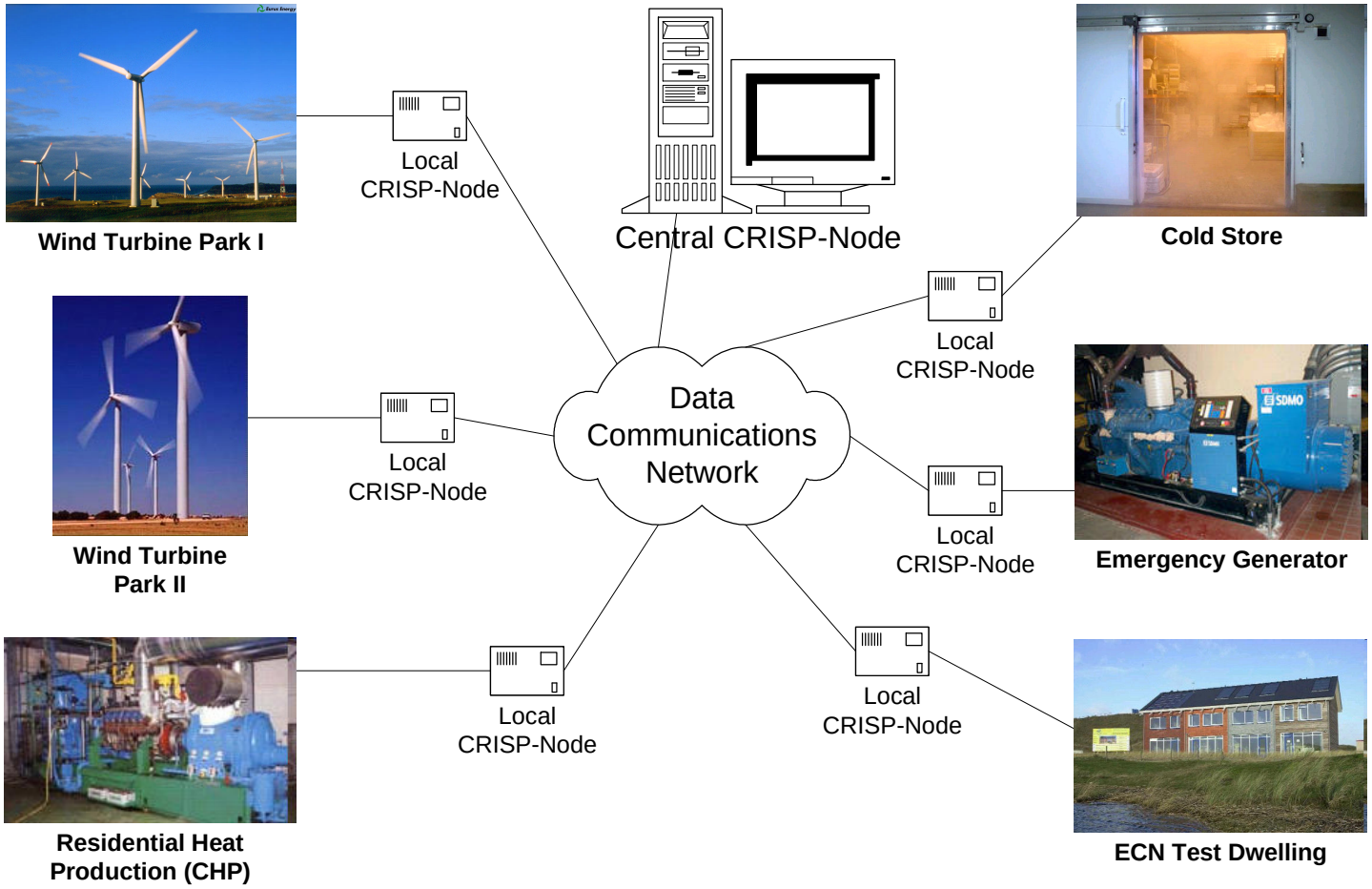
Distributed Control

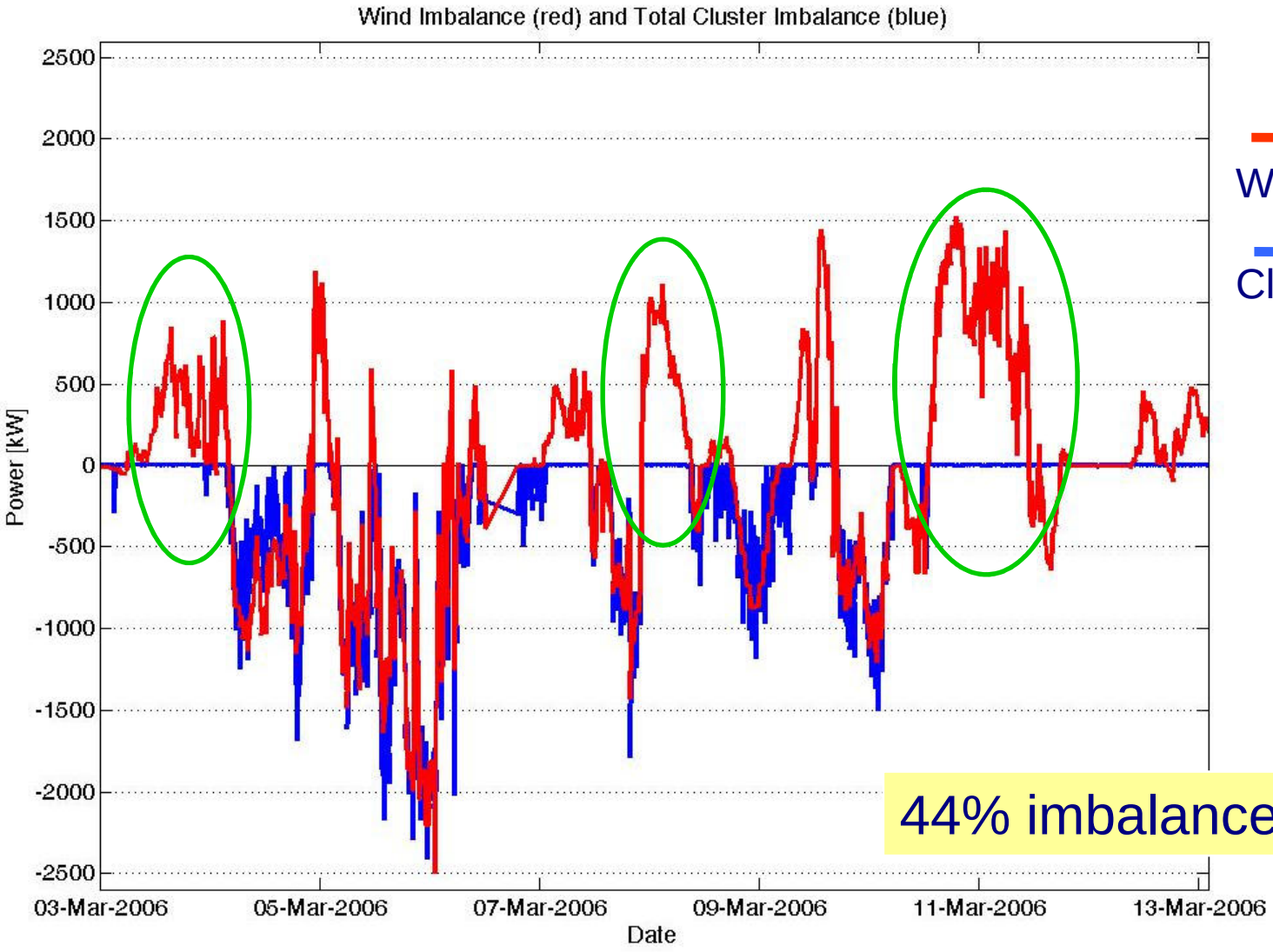
Electronic Markets

POWERMATCHER
smartgrid technology



Field experiment I : CRISP



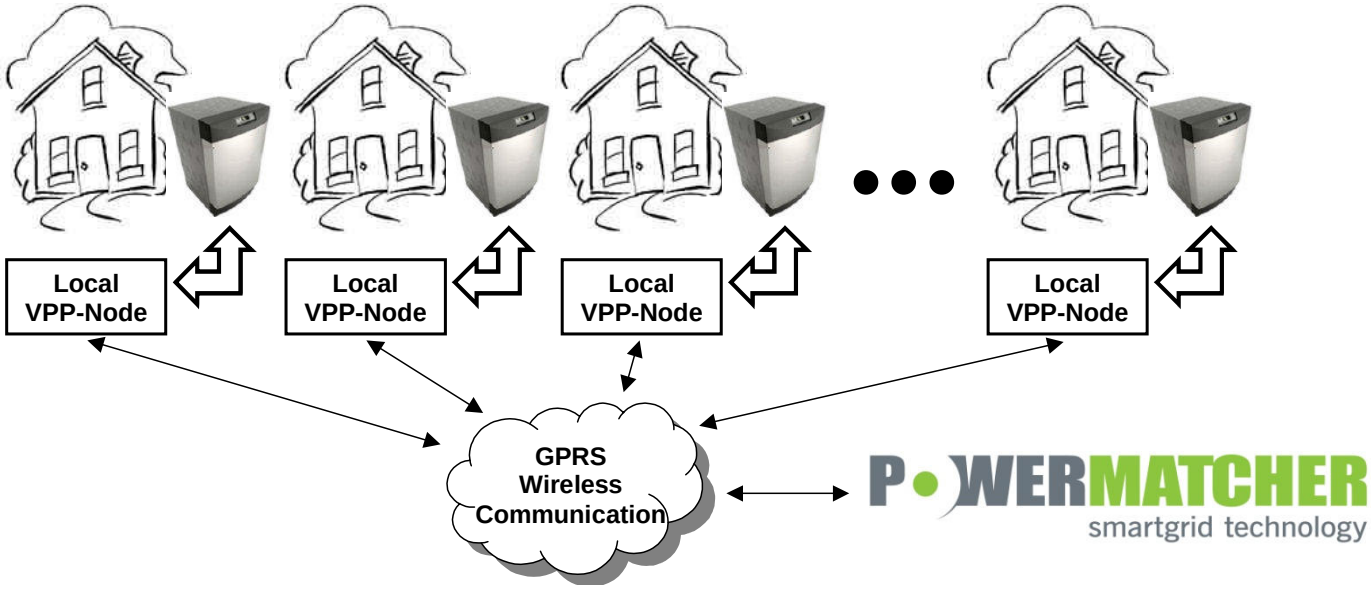


Wind imbalance

Cluster imbalance

44% imbalance reduction

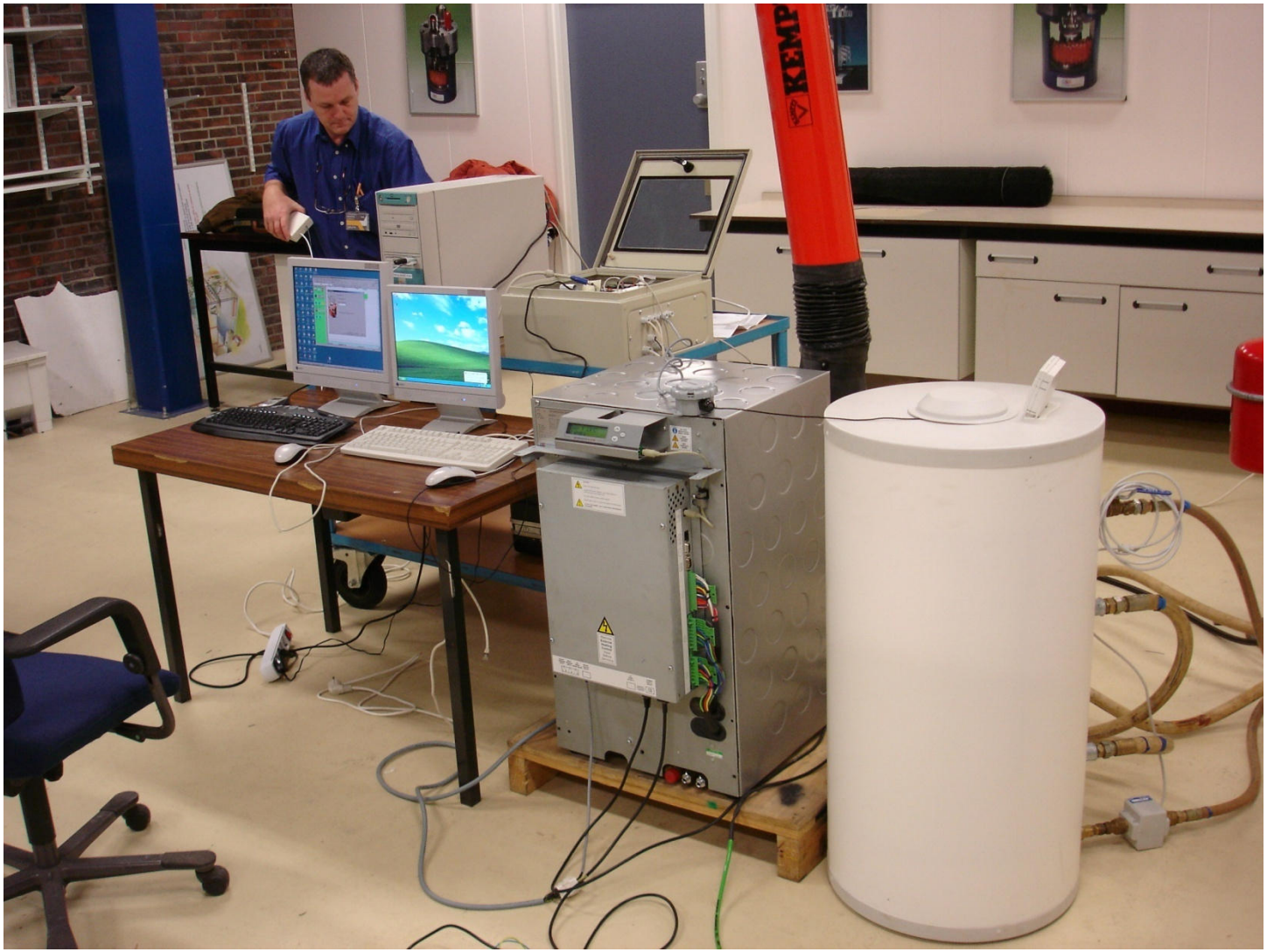
Field experiment III : First Trial

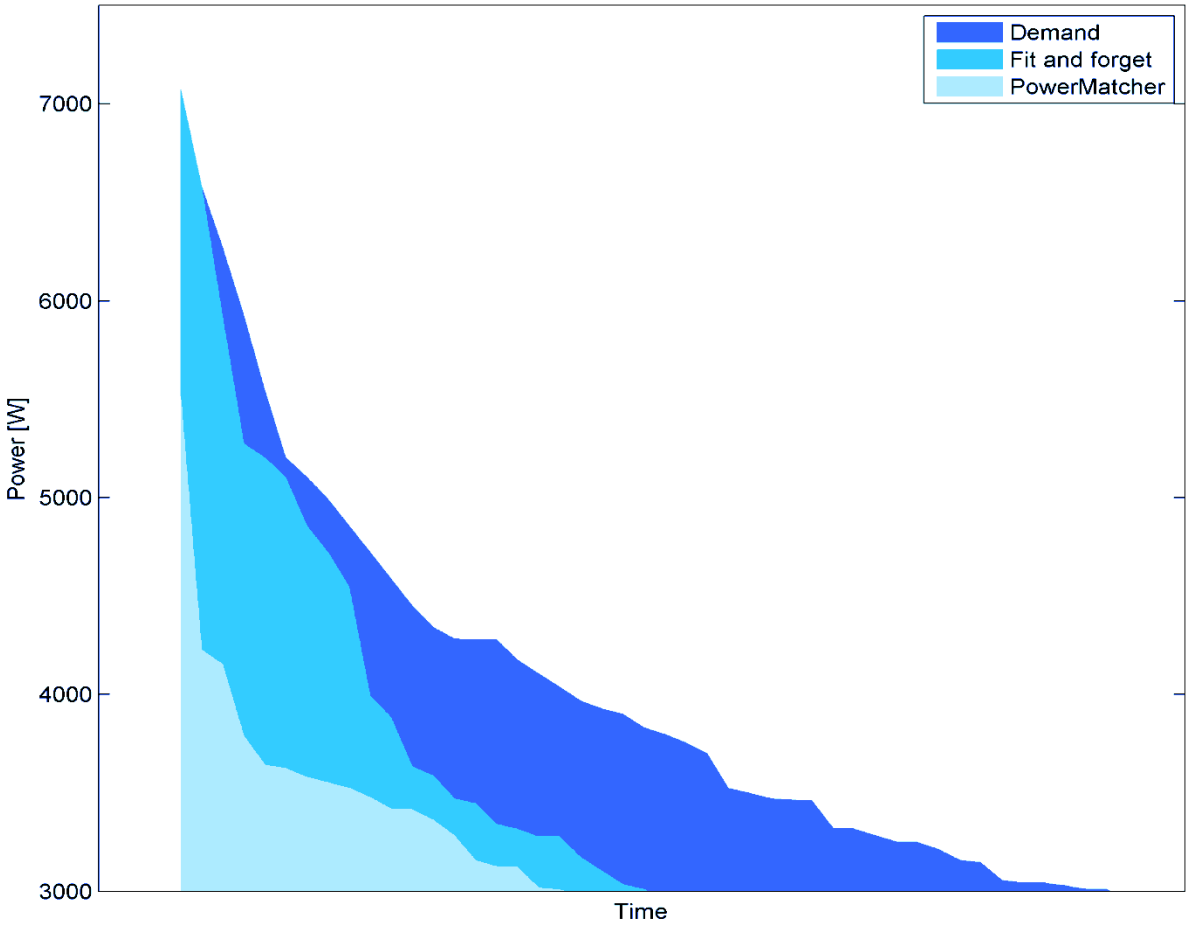


- 10 Households with micro-CHPs
- Peak reduction of local substation
- No infringement of user comfort

VPP node


ECN
Crisp Field Experiment
distributed intelligence in Critical Infrastructure for Sustainable Power
Wind Turbine Park I
Wind Turbine Park II
Residential Heat Production (CHP)
Local CRISP-Node
Central CRISP-Node
Data Communications Network
Cold Store
Emergency Generator
ECN Test Dwelling
ICT infrastructure is based on proven technologies:
• Industrial PC's
• Windows XP
• Windows .NET
• OPC
• ADSL communication
Energy research Centre of the Netherlands
CRISP

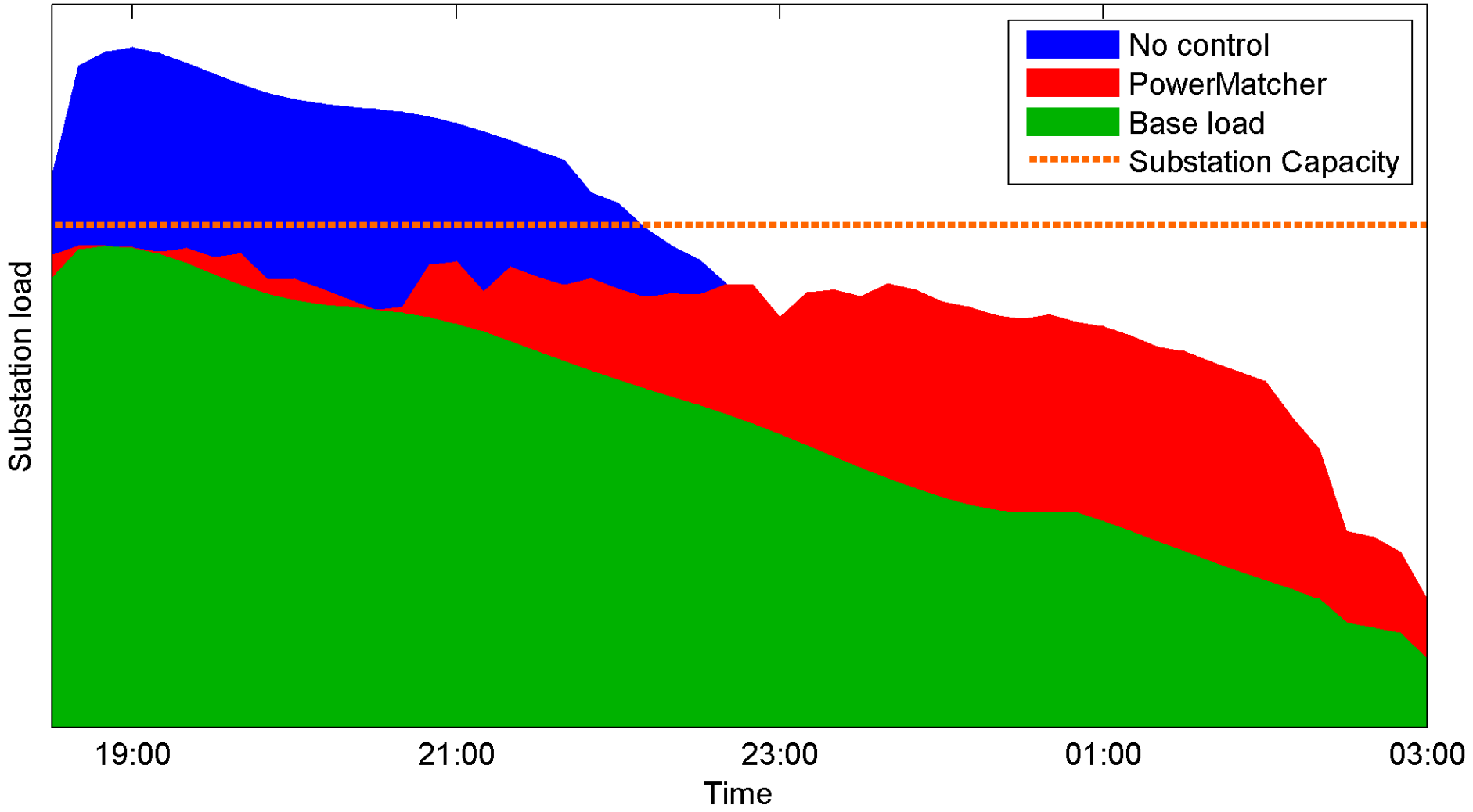

KEMP



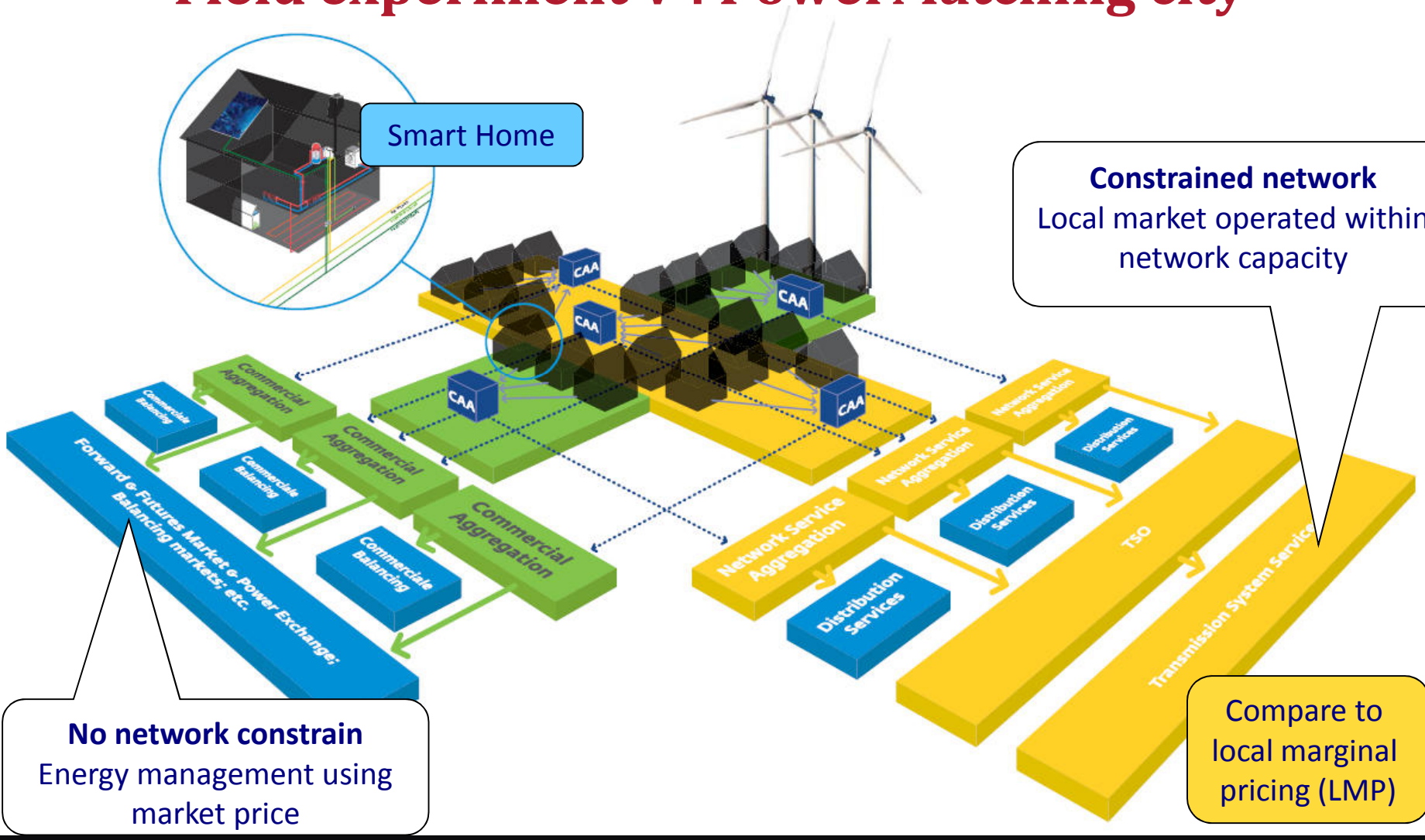
- "Fit and Forget" did not reduce substation peak load.
- PowerMatcher:
  - 50% peak reduction (winter)
  - 30% peak reduction (summer)

Field experiment IV : PHEV


I ♥ STOPCONTACTEN
ECN werkt aan de auto van de toekomst www.ecn.nl


No control
PowerMatcher
Base load
Substation Capacity
Substation load
19:00
21:00
23:00
01:00
03:00
Time

Field experiment V : PowerMatching city



Constrained network
Local market operated within network capacity

No network constrain
Energy management using market price

Compare to local marginal pricing (LMP)


Groningen
Amsterdam


Hoogkerk
Aduard
Dorkwerd
Garmerwolde
Noorddijk
Leegkerk
Oosterhoogebrug
Ruischerbrug
Middelbert
Lagemeeden
Hoogkerk
Groningen
Eemspoort
Westpoort
Euvelgunne
Engelbert
Stadspark
Winschoterdiep
Essen
Roodehaan
Waterhuizen
N355
N361
N370
N360
N46
N7
A7
A28
E22
N372


Hoogkerk-Vierverlaten
Hoendiep
Hoogkerk
Hoogkerk Oost
Vierverlaten
Koningsdiep
Matsloot
E22
A7
N372
Groningen Drenthe


Hoogkerk
PowerMatching City

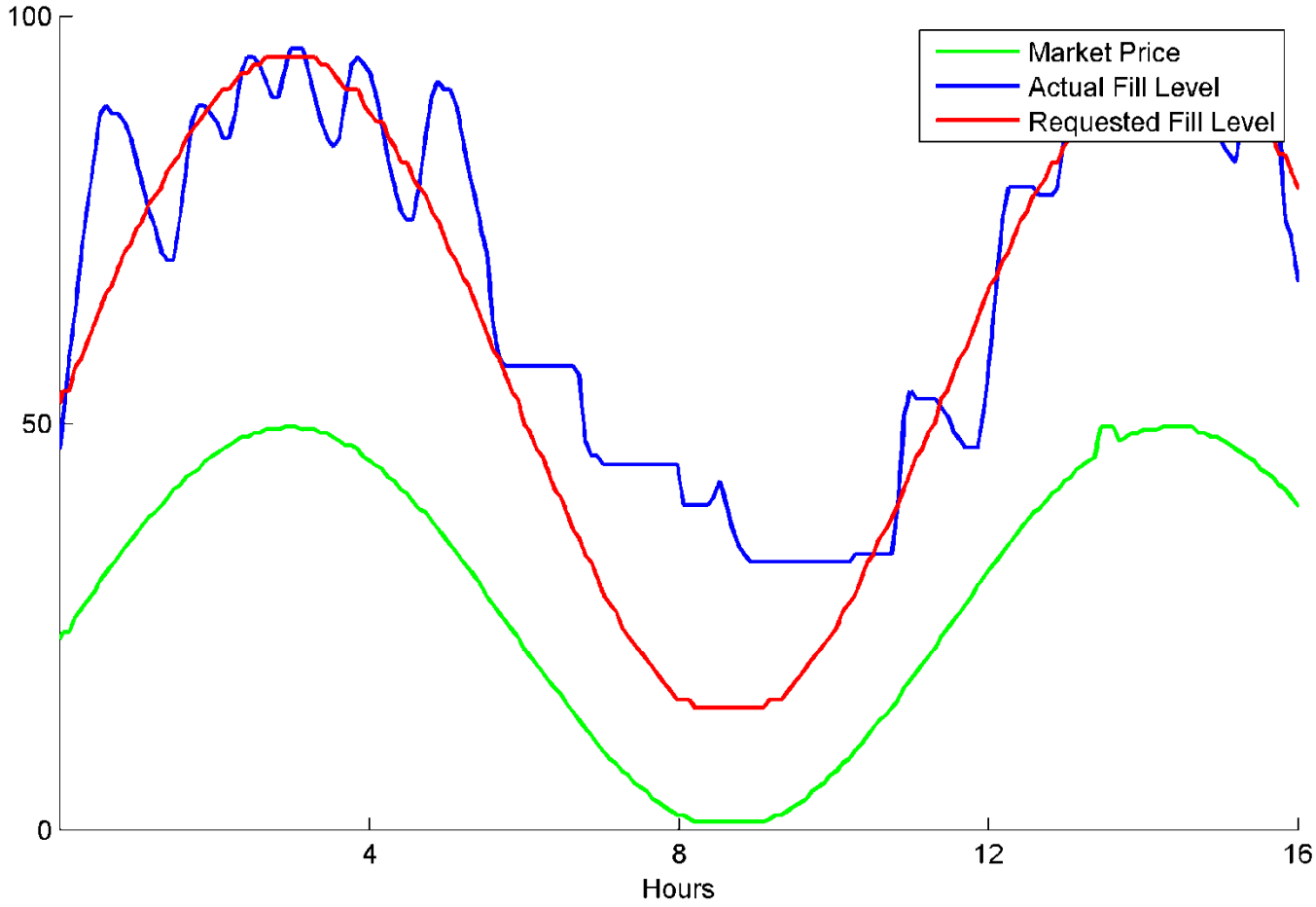






SAMSUNG

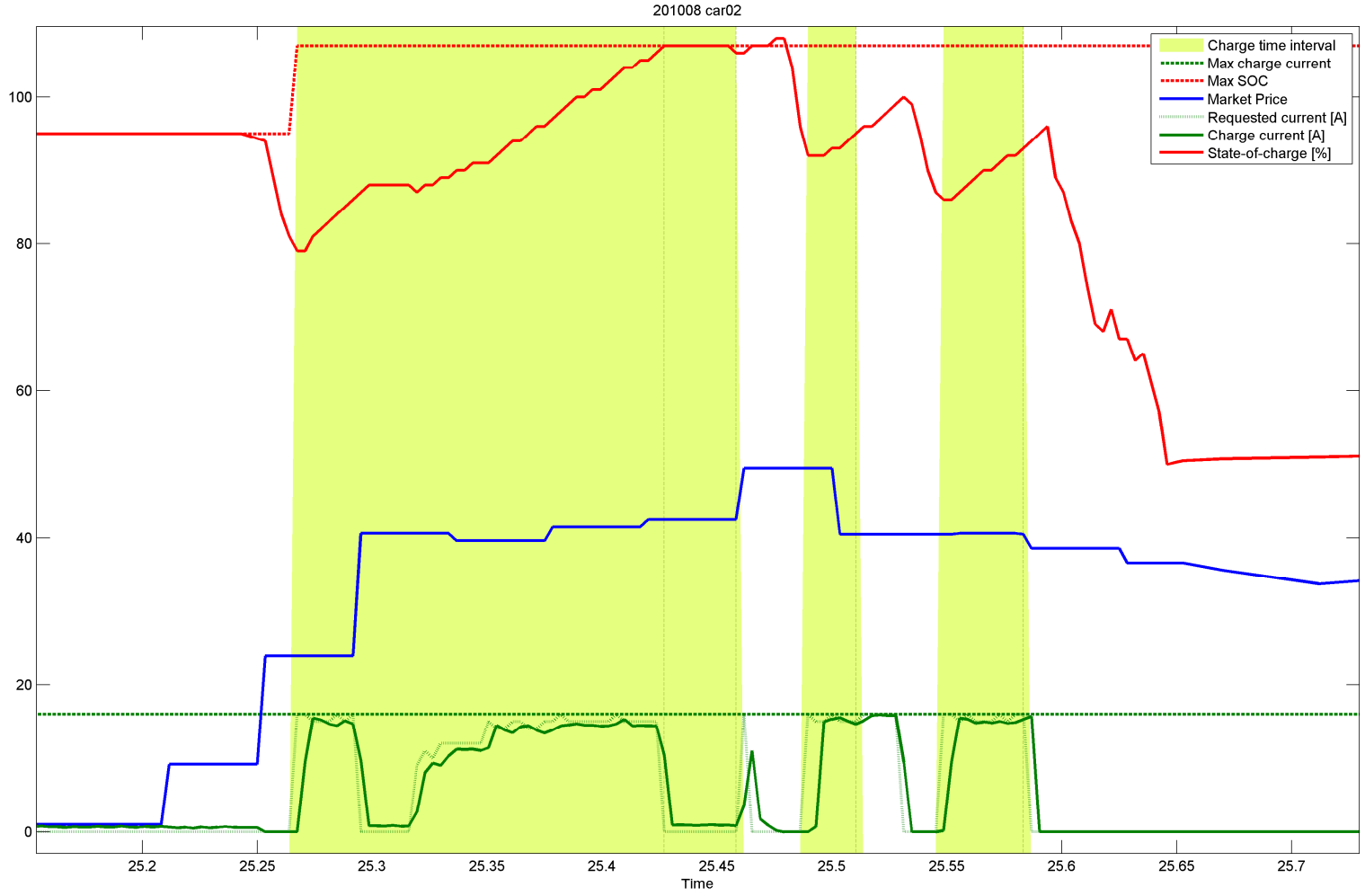
CHP buffer fill level

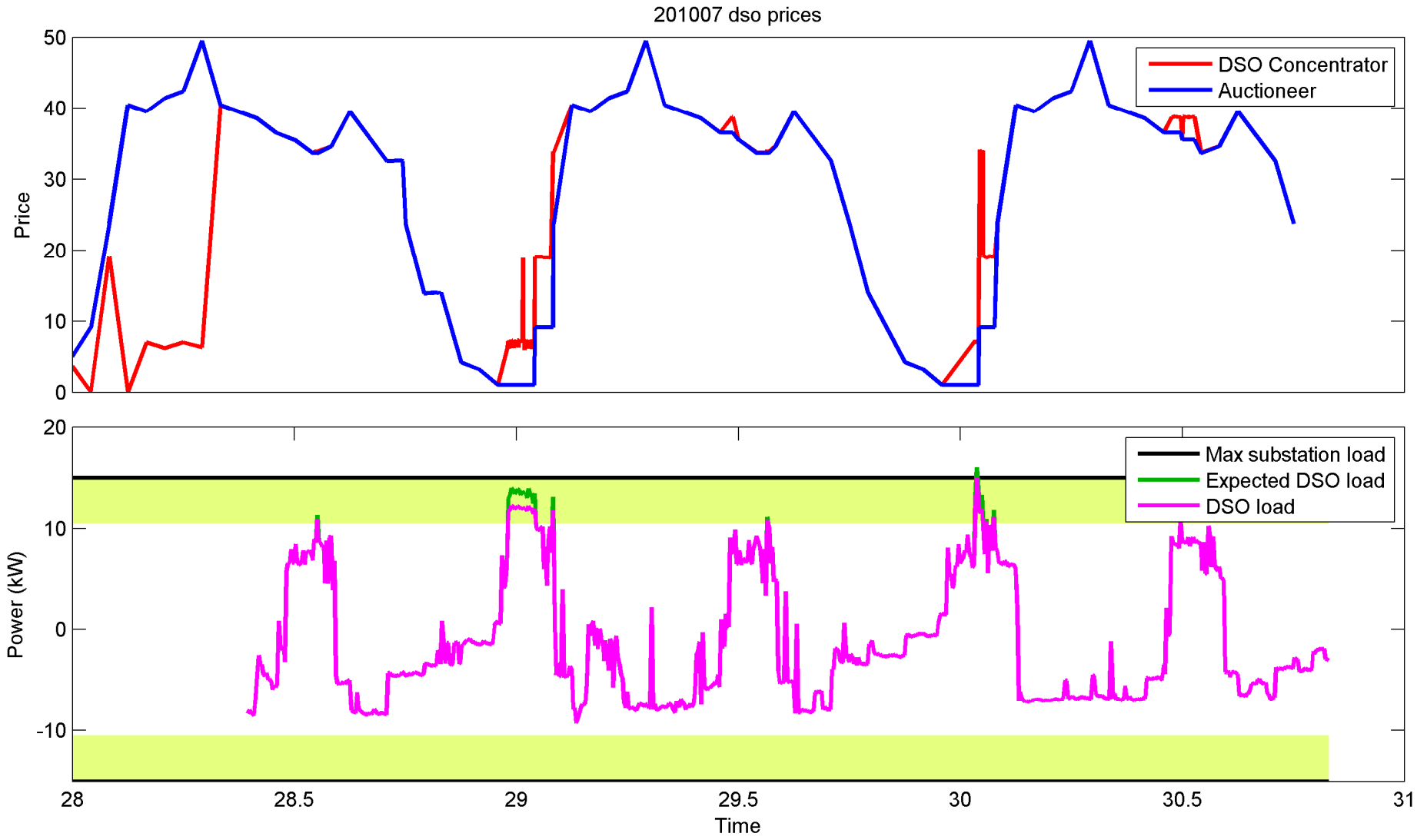


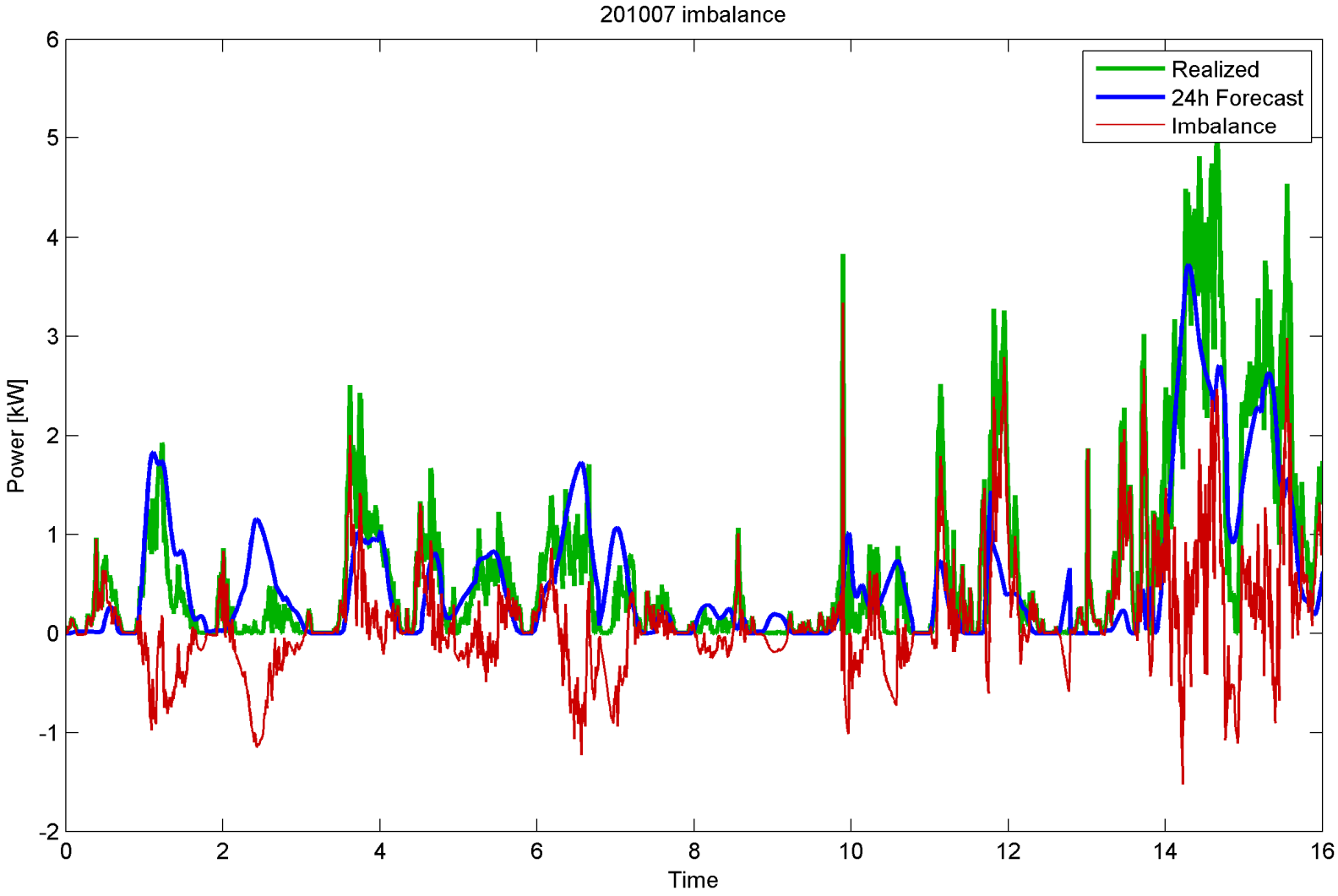

Business
Centre
Korenweide

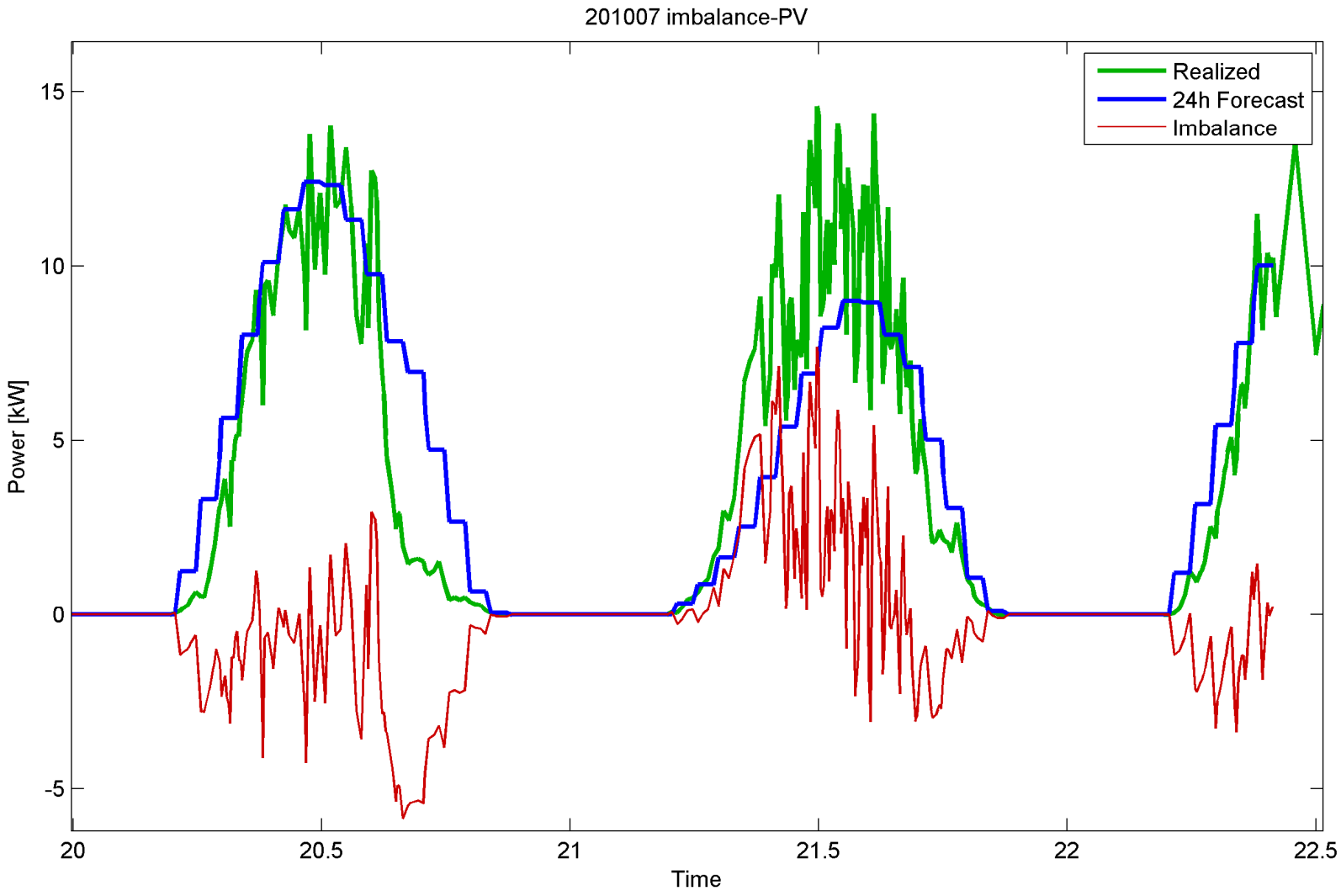

curver

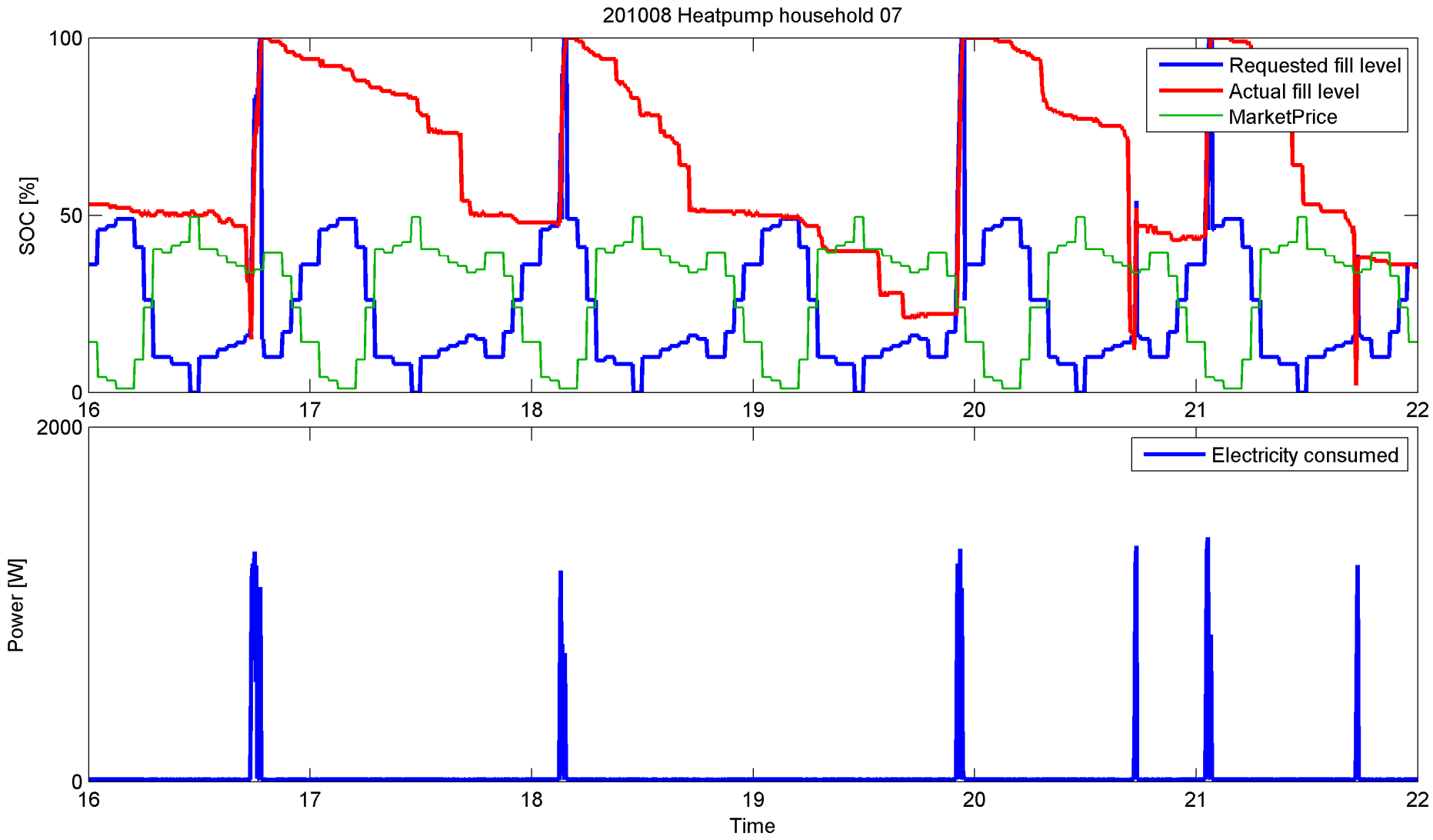

POWERMATCHER
smartgrid technology
Time: 19:08
Departure: 07:30
Charge level: 80 %
I-charge: 13.7 A
Set departure time:
Set charge level
Set charge current
www.powermatcher.net
MENU


201008 car02
Charge time interval
Max charge current
Max SOC
Market Price
Requested current [A]
Charge current [A]
State-of-charge [%]
100
80
60
40
20
0
25.2
25.25
25.3
25.35
25.4
25.45
25.5
25.55
25.6
25.65
25.7
Time


201007 dso prices
Price
DSO Concentrator
Auctioneer
Power (kW)
Max substation load
Expected DSO load
DSO load
Time


201007 imbalance
Realized
24h Forecast
Imbalance
Power [kW]
Time
6
5
4
3
2
1
0
-1
-2
0
2
4
6
8
10
12
14
16


201007 imbalance-PV
Realized
24h Forecast
Imbalance
Power [kW]
15
10
5
0
-5
20
20.5
21
21.5
22
22.5
Time


201008 Heatpump household 07
SOC [%]
100
50
0
Requested fill level
Actual fill level
MarketPrice
16
17
18
19
20
21
22
2000
Power [W]
0
Electricity consumed
Time